(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号
特開2000－266979
（P2000－266979A）
(43)公開日　平成12年９月29日(2000.9.29)

(51)Int.Cl.⁷	識別記号	ＦＩ		テーマコード（参考）
Ｇ０２Ｂ　7/02		Ｇ０２Ｂ　7/02	Ｂ	２Ｈ０４０
Ａ６１Ｂ　1/04	３７２	Ａ６１Ｂ　1/04	３７２	２Ｈ０４４
Ｇ０２Ｂ　23/24		Ｇ０２Ｂ　23/24	Ｂ	４Ｃ０６１
23/26		23/26	Ｃ	５Ｃ０２２
Ｈ０４Ｎ　5/225		Ｈ０４Ｎ　5/225	Ｄ	５Ｃ０２４

審査請求　未請求　請求項の数３　ＯＬ　（全８頁）　最終頁に続く

(21)出願番号　特願平11－69377

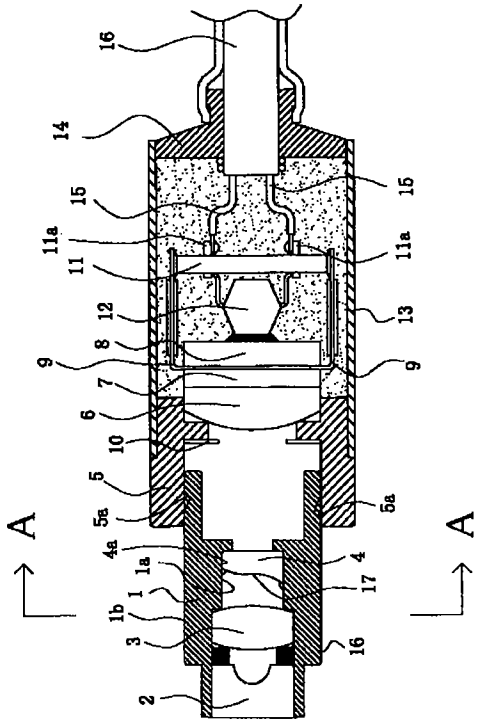
(22)出願日　平成11年３月16日(1999.3.16)

(71)出願人　000000376
オリンパス光学工業株式会社
東京都渋谷区幡ヶ谷２丁目43番２号
(72)発明者　菅　武志
東京都渋谷区幡ヶ谷２丁目43番２号　オリンパス光学工業株式会社内
(72)発明者　藤森　紀幸
東京都渋谷区幡ヶ谷２丁目43番２号　オリンパス光学工業株式会社内
(74)代理人　100065824
弁理士　篠原　泰司　（外１名）

最終頁に続く

(54)【発明の名称】　撮像装置

(57)【要約】
【課題】　回転非対称な表面形状を有する光学素子を含む光学系の正確且つ高精度な位置決めが可能な撮像装置を提供すること。
【解決手段】　撮像装置は、回転非対称な表面形状を有す光学素子４を含んだ対物光学系と、回転非対称な開口形状を有する明るさ絞り１７と、固体撮像素子８と、これらを保持する保持手段１，５を備えており、前記固体撮像素子４と保持手段１，５には、光軸に対する回転方向の位置出し手段（非円形部）４ａ，１ａ，１ｂ，５ａがそれぞれ設けられ、前記明るさ絞り１７は前記光学素子４の表面に蒸着されている。



【特許請求の範囲】
【請求項１】　回転非対称な表面形状を有する光学素子を少なくとも一つ含んだ光学系と、回転非対称な開口形状を有する明るさ絞りと、固体撮像素子と、前記光学素子，明るさ絞り及び固体撮像素子を夫々保持する保持手段とを有する撮像装置において、前記光学素子と明るさ絞りの光軸に対する回転方向の位置出し手段を設けたことを特徴とする撮像装置。
【請求項２】　Ｚを光学系の光軸、Ａを係数、Ｘを固体撮像素子の画素配列の水平（走査）方向（モニターの水平方向）と平行で前記Ｚ軸に直交する軸、Ｙを固体撮像素子の画素配列の垂直（走査方向に直交）方向（モニター上の垂直方向）と平行で前記Ｚ軸に直交する軸としたとき、前記光学素子はＺ＝Ａ（X^3 ＋Y^3 ）を満たす３次元曲面で表わされる表面形状を有している請求項１に記載の撮像装置。
【請求項３】　前記光学素子及び／又は明るさ絞りは、非円形部分を含む外形を有していて、該非円形部分により前記固体撮像素子に対する回転位置決めが行われるようになっている請求項１に記載の撮像装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、回転非対称な表面形状を有する光学素子を少なくとも一つ含んだ対物光学系と、回転非対称な開口形状を有する明るさ絞りと、固体撮像素子とを有する撮像装置に関する。
【０００２】
【従来の技術】近年、内視鏡の細長い挿入先端部にＣＣＤなどの固体撮像素子を内蔵させ、固体撮像素子の撮像面上に観察対象部位の観察像を対物レンズで結像させて得られる電気信号を、信号ケーブルを介して内視鏡の外部に設置した画像処理装置へ伝送し、画像信号に変換してモニター上に観察対象部位の画像を表示させることにより観察が行えるようにした電子内視鏡が広く利用されている。
【０００３】また、観察像を固体撮像素子上に結像させるのに用いられる対物レンズも多様化しており、複雑な表面形状を有する対物レンズが組み込まれることもある。例えば、ＰＣＴ／ＵＳ　９６／０１５１４などに開示されているように、回転非対称な光学素子を用いて光学系の空間周波数特性を変換し、光学系の被写界深度を拡大するようにした技術が提案されている。この技術の場合、回転非対称な光学素子により回転非対称なボケ（回転非対称な収差）が発生するため、電気的な信号処理によりこのボケを補正し、結果として通常のレンズ系を用いる場合よりも遙かに広い被写界深度範囲に渡って高画質の画像が得られるという特徴を有している。
【発明が解決しようとする課題】
【０００４】ところで、通常、この目的で用いられる信号処理系は、光学像が或る特定の状態にあることを前提として構成されているので、光学像が予定のものとは異なる状態になると、補正が効かなくなり、画質が大きく劣化してしまうという問題点がある。また、この種の撮像装置では、回転非対称な表面形状を有する光学素子を用いるので、回転対称な通常のレンズを用いる場合とは異なり、光学素子の高精度の位置決めと回転方向の正確な位置決めが必要となる。
【０００５】本発明は、従来技術の有するこのような問題点に鑑みてなされたものであり、その目的とするところは、回転非対称な表面形状を有する光学素子を含む光学系の正確且つ高精度の位置決めが可能な撮像装置を提供することにある。
【０００６】
【課題を解決するための手段】上記目的を達成するため、本発明による撮像装置は、回転非対称な表面形状を有する光学素子を少なくとも一つ含んだ光学系と、回転非対称な開口形状を有する明るさ絞りと、固体撮像素子と、前記光学素子，明るさ絞り及び固体撮像素子を夫々保持する保持手段とを有する撮像装置において、前記光学素子と明るさ絞りの光軸に対する回転方向の位置出し手段を設けたことを特徴としている。
【０００７】本発明によれば、Ｚを光学系の光軸、Ａを係数、Ｘを固体撮像素子の画素配列の水平（走査）方向（モニターの水平方向）と平行で前記Ｚ軸に直交する軸、Ｙを固体撮像素子の画素配列の垂直（走査方向に直交）方向（モニター上の垂直方向）と平行で前記Ｚ軸に直交する軸としたとき、前記光学素子はＺ＝Ａ（X^3 ＋Y^3 ）を満たす３次元曲面で表わされる表面形状を有している。
【０００８】また、本発明によれば、前記光学素子及び／又は明るさ絞りは、非円形部分を含む外形を有していて、該非円形部分により前記固体撮像素子に対する回転位置決めが行われるようになっている。
【０００９】
【発明の実施の形態】以下、本発明の実施の形態を図示した実施例に基づき説明する。
実施例１
図１は本発明に係る（内視鏡用）撮像装置の第１実施例の全体構成を示す断面図、図２（ａ）は図１の撮像装置に用いられる回転非対称な表面形状を有する光学素子の正面図、図２（ｂ）はその斜視図、図３（ａ）は図２に示した回転非対称な表面形状を有する光学素子の変形例の正面図、図３（ｂ）はその斜視図、図４は図１のＡ－Ａ線断面図である。図中、１はレンズ保持枠、２はレンズ保持枠１に保持された凹レンズ、３はレンズ保持枠１に保持された凸レンズ、４はレンズ保持枠１に接着保持された回転非対称な表面形状を有する光学素子（以下、回転非対称光学素子と云う）、５はレンズ保持枠１に嵌着されたＣＣＤ保持枠、６はＣＣＤ保持枠５に接着固定された凸レンズ、７はＣＣＤ保持枠５に接着固定された

カバーガラス、８は凸レンズ６と光学的中心を一致させた状態でカバーガラス７に接着固定されていて撮像面側の面の端部にフレキシブルリード９がバンプ接合されているＣＣＤなどの固体撮像素子、１０は開口中心が凸レンズ６の光学的中心と一致するようにＣＣＤ保持枠５に取り付けられたフレア絞り、１１は固体撮像素子８の撮像面とは反対側の面に電気絶縁性接着剤により接着固定された電子部品（トランジスタ）１２を介して保持されていて両側面にフレキシブルリード９の各自由端が半田付けされている回路基板、１３はＣＣＤ保持枠５の嵌着されたシールドケース、１４はシールドケース１３の開口端を閉塞するケーブルホルダー、１５は回路基板１１に接続固定された複数の接続端子１１ａに夫々接続された複数の信号ケーブル、１６は複数の信号ケーブル１５を束ねてケーブルホルダー１４に挿通された信号ケーブル束である。

【００１０】凸レンズ６とカバーガラス７と固体撮像素子８は、紫外線硬化と熱硬化併用型の光学接着剤により、フレア絞り１０や固体撮像素子８の光学的中心を凸レンズ６の光軸と一致させた状態で互いに接着固定されているが、回転非対称光学素子４にて発生する回転非対称な収差が大きい場合などは、フレア絞り１０や固体撮像素子８の光学的中心を光軸に対して偏心させて設けても良い。回路基板１１の電子部品１２が設けられている側とは反対側の面には、図示しないがチップコンデンサやチップ抵抗などの電子部品が高融点クリーム半田により接続固定されている。フレキシブルリード９には電気絶縁のためポリイミドテープが貼られており、ＣＣＤ保持枠５とシールドケース１３とケーブルホルダー１４とで画成された空間には接着剤が充填されていて、これらの構成部品を一体的に固定している。

【００１１】回転非対称光学素子４の表面（凸レンズ３側の面）の形状は、凹レンズ２と凸レンズ３及び６を含む対物光学系の光軸中心をＸ軸及びＹ軸の原点としたとき、$Z=A(X^3+Y^3)$を満たす３次元曲面である。この場合、Ｚ軸とＸ軸とＹ軸は互いに直交しており、Ｚ軸は対物光学系の光軸、Ａは係数、Ｘ軸は固体撮像素子８の画素配列の水平（走査）方向（モニターの水平方向）と平行、Ｙ軸は固体撮像素子８の画素配列の垂直（走査方向に直交）方向（モニター上の垂直方向）と平行である。この表面には、図２に示すように正方形の開口部１７ａを有する明るさ絞り１７が蒸着により設けられていて、凹レンズ２と凸レンズ３を透過して入射して来た光束を所定の大きさに絞るようになっている。

【００１２】回転非対称光学素子４の裏面（凸レンズ６側の面）は平面であり、レンズ保持枠１に設けられた突当部に付き当てられて位置決めされた状態で外周部がレンズ保持枠１に接着固定されている。また、回転非対称光学素子４の円周の一部には非円形部４ａが設けられていて、この非円形部４ａがこれに対応してレンズ保持枠１の内周面に形成された非円形部１ａ（図４参照）と係合することにより、回転非対称光学素子４の回転方向の位置決めが行われている。この例では、円形のレンズの外周部の対向する一部分を平坦にすることにより非円形部が形成されている。従って、回転非対称光学素子４はレンズ保持枠１に対し光軸を中心とする回転方向にも高精度の位置決めがなされ得る。図２に示す実施例では、非円形部４ａが回転非対称光学素子４の一箇所のみに設けられているが、図３に示すように対向する二箇所に設けられても良く、その数は限定されない。この場合、レンズ保持枠１にも対応して非円形部１ａが二箇所に設けられることは云うまでもない。図示しないが同様にレンズ保持枠１とＣＣＤ保持枠５にそれぞれ非円形部を設け、レンズ保持枠１の非円形部１ｂとＣＣＤ保持枠５の非円形部５ａを係合させることにより回転方向の位置決めを行っている。即ち、回転非対称光学素子４と固体撮像素子８は光軸を中心とした回転方向に高精度に位置決めされることになる。以上により、回転非対称光学素子４の表面形状が$Z=A(X^3+Y^3)$を満たす形状の場合、Ｘ軸は固体撮像素子８の画素配列の水平（走査）方向（モニター上の水平方向）と平行、且つ、Ｙ軸は固体撮像素子８の画素配列の垂直（走査方向に直交）方向（モニター上の垂直方向）と平行となるように、光軸（Ｚ軸）を中心とした回転方向に高精度に位置決めすることが可能となる。

【００１３】ここで、回転非対称光学素子４の製造方法について説明する。この回転非対称光学素子４はモールドまたはプレス等により形成されるが、その形成工程において、図２に示すように素子表面の光学的に光束が通過することのない部分にアライメントマーク（基準マーク）４ｂを設ける。例えば、図示しないがプレス型に素子の表面形状と共にアライメントマーク４ｂの型が刻み込まれており、プレス工程で素子の表面形状を形成するのと同時にアライメントマーク４ｂが打ち込まれる。アライメントマーク４ｂは図２及び３に示すように少なくとも二つ設けられ、例えば十字型をしている。次に、このアライメントマーク４ｂを基準として、蒸着によって形成される明るさ絞り１７の開口部１７ａをパターニングする。実施例では開口部１７ａの形状を正方形としたが、長方形，八角形，円形その他何れにしても良い。また、回転非対称光学素子４の中心と開口部１７ａの中心とを所定量ずらしても良い。非円形部４ａも同様にしてアライメントマーク４ｂを基準にして加工される。

【００１４】このように、回転非対称な光学素子であっても製造時にアライメントマーク４ｂが刻み込まれているので、次工程において素子の方向性を容易に判別することができ、また、このアライメントマーク４ｂを基準として、蒸着により素子の表面上に高精度で光学絞りを形成することが可能である。素子外形の非円形部もアライメントマーク４ｂを基準に高精度で位置決めされてか

ら加工処理されるので、精度の高いこの種光学素子を製造することが可能となり、レンズ枠内への素子の高精度な位置決め及び保持が容易である。また、アライメントマーク４ｂは光線が通過しない部分に刻設されているので、光学的に何らの影響を及ぼすこともない。

【００１５】ところで、本発明による撮像装置では、回転非対称光学素子４により回転非対称なボケ（回転非対称な収差）が発生しているため、通常のピント出しはできない。通常のピント出し（光軸方向（Ｚ方向）の調整）作業では、所定位置にチャート等の被写体を置き、その像をモニターで観察しながらピントが合うようにレンズ保持枠１とＣＣＤ保持枠５の光軸方向の調整を行い、両者を固定するようにしている。しかし、本実施例では、回転非対称光学素子４により回転非対称なボケ（回転非対称な収差）が発生しているため、上記のような通常のピント出しはできない。従って、本実施例の場合は、電気的な信号処理を併用し、回転非対称なボケ（回転非対称な収差）を補正した像をモニターで観察しながら、上述のピント出し作業を行なうようにする。

【００１６】また、レンズ保持枠１の外周面に形成された非円形部１ｂ（図４参照）とＣＣＤ保持枠５の内周面に対応して形成される非円形部５ａ（図１参照）に自由度（アソビ）を残して置くようにして、上記の信号処理を併用したピント出し作業の際に、レンズ保持枠１とＣＣＤ保持枠５の回転方向の調整を行って固定するようにしても良い。この場合には、光学系のピント出し作業と回転非対称光学素子４の回転方向の位置出し作業とを同時に行えるので便利である。また、画像を基に調整を行なうため、信号処理で想定している収差と実際の光学系で発生している収差との間のズレ量を最小にすることができる。従って、画質を向上させることができると共に、製造段階での歩留まりも向上させることが可能となる。

【００１７】このように、本実施例によれば、回転非対称な表面形状を有する光学素子を用いても、この光学素子とこの光学素子を保持するレンズ保持枠とに、対応する非円形部の如き光軸に対する回転方向の位置出し手段を設けたから、この光学素子を高精度で位置決めすることができ、また、回転非対称な開口形状を有する明るさ絞りもこの光学素子の表面に蒸着されているので、同様に高精度で位置決めされて十分な光学性能を実現することができる。

【００１８】実施例２

図５は本発明に係る（内視鏡用）撮像装置の第２実施例の全体構成を示す断面図、図６は図５に示した撮像装置の外観斜視図、図７は図５に示した撮像装置に用いられている回転非対称光学素子の斜視図、図８は図５のＢ－Ｂ線断面図、図９（ａ）は図７に示したのとは異なる回転非対称光学素子の正面図、図９（ｂ）は図９（ａ）のＣ－Ｃ線断面図である。図中、第１実施例に示したのと実質上同一の部材及び部分には同一符号が用いられ、説明は省略されている。この実施例は、回転非対称光学素子４の構造と該素子４のレンズ保持枠１への取り付け構造が、第１実施例とは異なる。即ち、回転非対称光学素子４の表面（凸レンズ３側の面）には、図７に明示されたように円形の外形の一部に非円形部（光軸方向のキー溝）４ａとアライメントマーク４ｂの穿設された環状の平面部４ｃと、この平面部４ｃよりも僅かに突出した第１実施例と同様の３次元曲面部４ｄとが形成されていて、この３次元曲面部４ｄ上に開口１７ａを有する明るさ絞り１７が蒸着により設けられている。この場合、３次元曲面部４ｄは図９に示すように平面部４ｃよりも凹んだ位置に形成して明るさ絞り１７を蒸着するようにしても良い。

【００１９】回転非対称光学素子４の裏面（凸レンズ６側の面）は平面であって、この素子４は、図５に示された如く、平面部４ｃをレンズ保持枠１に設けられた突当部に突き当てて位置決めした状態で外周部をレンズ保持枠１に接着することにより固定される。この実施例では、回転非対称光学素子４の回転方向の位置決めは、非円形部４ａとこれに対応してレンズ保持枠１及びＣＣＤ保持枠５に形成された非円形部（キー溝）１ｃ及び５ｂとに共通にキー１８を嵌装することにより、行われる。これにより、回転非対称光学素子４は、レンズ保持枠１とＣＣＤ保持枠５に対して光軸の周りの回転方向にも高精度で位置決めされ得る。

【００２０】本実施例では、非円形部１ｃ，４ａ，５ｂがレンズ保持枠１，回転非対称光学素子４，ＣＣＤ保持枠５にそれぞれ一つずつ何れも凹型溝として形成されたが、これらは複数箇所に設けられても良く、また、Ｖ型溝（図９（ａ）参照）またはＵ型溝として一箇所または複数箇所に形成され、これに対応してキー１８も横断面形状がＶ型またはＵ型に形成されたものを用いるようにしても良い。更に、凹型溝の代わりに凸型を形成して、この凸型をキー溝１ｃに係合されるようにしても良い。また、明るさ絞り１７は３次元曲面４ｄ上に蒸着により形成されたが、図９に示すように平面部４ｃに例えばリン青銅板などで作られた開口部１７ａ′を有する平面板状明るさ絞り１７′を接合することにより構成してもよい。この場合、明るさ絞り１７′を回転非対称光学素子４と接合して一体化した後、凸型，Ｖ型溝またはＵ型溝などの非円形部４ａを設けて置くと、同様に回転方向の位置決めが可能である。なお、明るさ絞り１７，１７′の開口部１７ａ，１７ａ′の各辺はＸ軸，Ｙ軸とそれぞれ平行であり、その中心は光軸と一致している。その他本実施例の作用効果は第１実施例のそれらと同様であるので、説明を省略する。

【００２１】以上説明したように、本発明の撮像装置は、特許請求の範囲に記載した特徴のほかに、下記の特徴を有している。

（１）前記位置出し手段は、前記光学素子の表面上に設けられたアライメントマークを基準として前記光学素子に形成されている請求項１に記載の撮像装置。

【００２２】（２）前記明るさ絞りは前記光学素子の表面に蒸着されている請求項１に記載の撮像装置。

【００２３】（３）前記明るさ絞りは非円形部を有する前記光学素子表面の所定位置に一体的に付設されており、前記光学素子は前記非円形部を前記保持枠に対応して形成された非円形部に係合させることにより前記保持枠に保持されるようになっている請求項１に記載の撮像装置。

【００２４】（４）前記明るさ絞りの開口形状は長方形または正方形である請求項１に記載の撮像装置。

【００２５】（５）前記光学素子を含む対物光学系と前記固体撮像素子との位置決めを、画像処理を併用して前記固体撮像素子からの画像信号をテレビモニターで観察しながら行なうようにした請求項１に記載の撮像装置。

【００２６】（６）回転非対称な表面形状を有する光学素子を製造する方法において、前記表面形状を形成すると同時に基準マークを刻設し、該基準マークをもとに前記光学素子の後加工処理を行なうようにしたことを特徴とする方法。

【００２７】（７）Ｚを前記対物光学系の光軸、Ａを係数、Ｘを前記固体撮像素子の画素配列の水平（走査）方向（モニターの水平方向）と平行で前記Ｚ軸に直交する軸、Ｙを前記固体撮像素子の画素配列の垂直（走査方向に直交）方向（モニター上の垂直方向）と平行で前記Ｚ軸に直交する軸としたとき、前記光学素子の表面形状は$Z=A(X^3+Y^3)$を満たす３次元曲面である請求項１に記載の光学素子の製造方法。

【００２８】

【発明の効果】上述の如く本発明によれば、簡単な構成にも拘わらず、回転非対称な表面形状を有する光学素子を含む対物光学系の高精度な位置決めが可能であり、広い被写界深度範囲に渡って高画質の画像を得ることのできる撮像装置を提供することができる。

【図面の簡単な説明】

【図１】本発明に係る撮像装置の第１実施例の全体構成を示す断面図である。

【図２】（ａ）は第１実施例に用いられている回転非対称な表面形状を有する光学素子の正面図、（ｂ）はその斜視図である。

【図３】（ａ）は図２に示した光学素子の変形例の正面図、（ｂ）はその斜視図である。

【図４】図１のＡ－Ａ線に沿う断面図である。

【図５】本発明に係る撮像装置の第２実施例の全体構成を示す断面図である。

【図６】図５に示した撮像装置の外観斜視図である。

【図７】第２実施例に用いられている回転非対称な表面形状を有する光学素子の斜視図である。

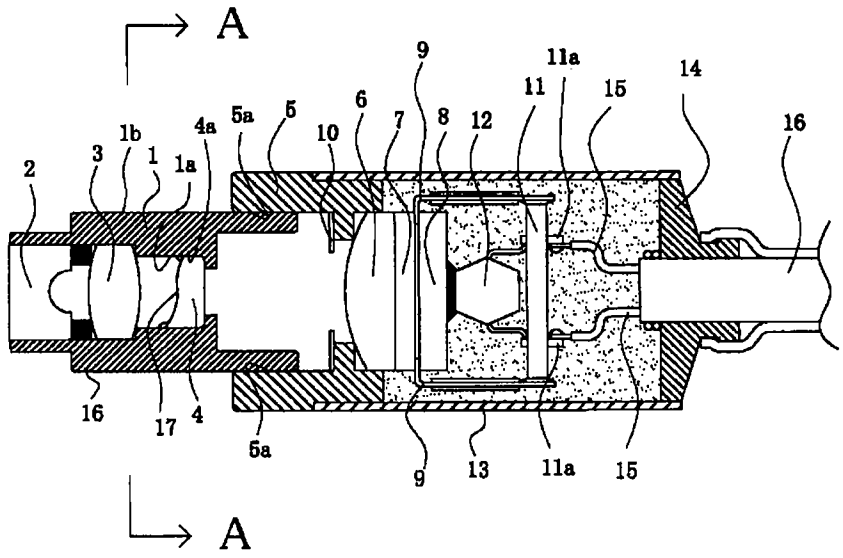
【図８】図５のＢ－Ｂ線に沿う断面図である。

【図９】（ａ）は図７に示したのとは異なる回転非対称な表面形状を有する光学素子の正面図、（ｂ）は（ａ）のＣ－Ｃ線に沿う断面図である。

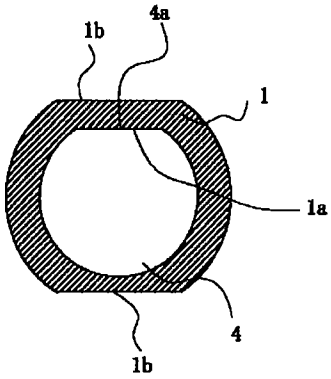
【符号の説明】

１	レンズ保持枠
１ａ	非円形部
１ｂ	非円形部
１ｃ	非円形部
２	凹レンズ
３，６	凸レンズ
４	回転非対称な表面形状を有する光学素子
４ａ	非円形部
４ｂ	アライメントマーク
４ｃ	平面部
４ｄ	３次元曲面部
５	ＣＣＤ保持枠
５ａ	非円形部
５ｂ	非円形部
７	カバーガラス
８	固体撮像素子
９	フレキシブルリード
１０	フレア絞り
１１	回路基板
１１ａ	接続端子
１２	電子部品
１３	シールドケース
１４	ケーブルホルダー
１５	信号ケーブル
１６	信号ケーブル束
１７，１７′	明るさ絞り
１７ａ，１７ａ′	開口部
１８	キー

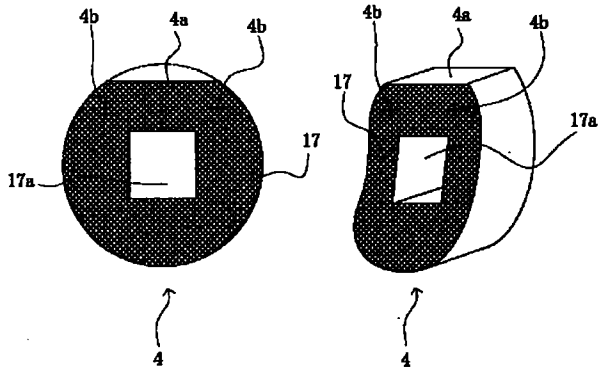
【図１】



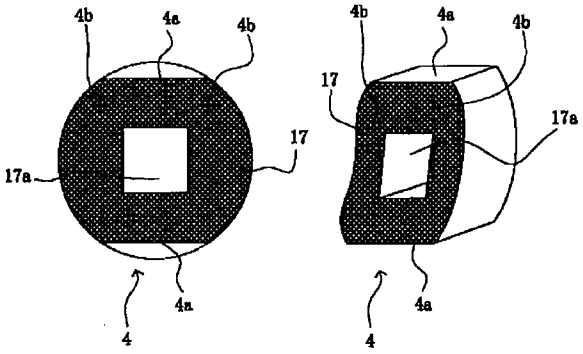
【図４】



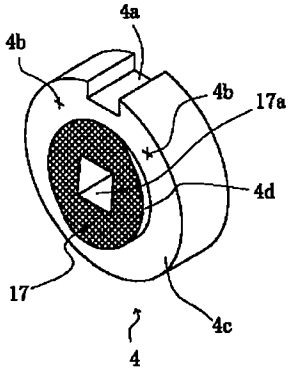
【図２】



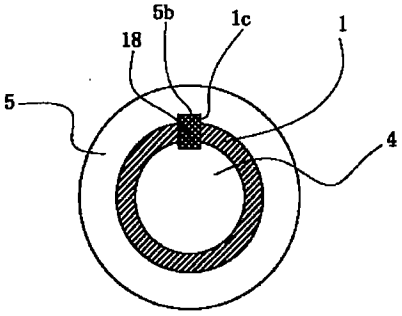
【図３】



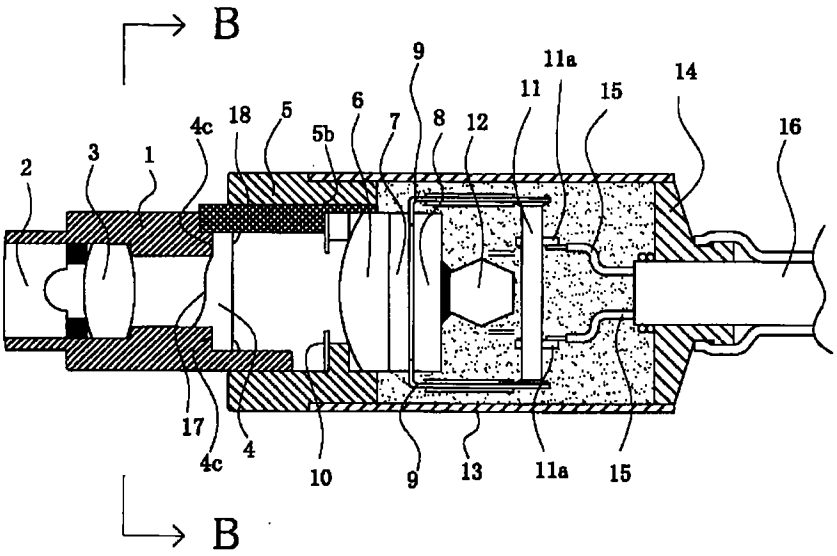
【図７】



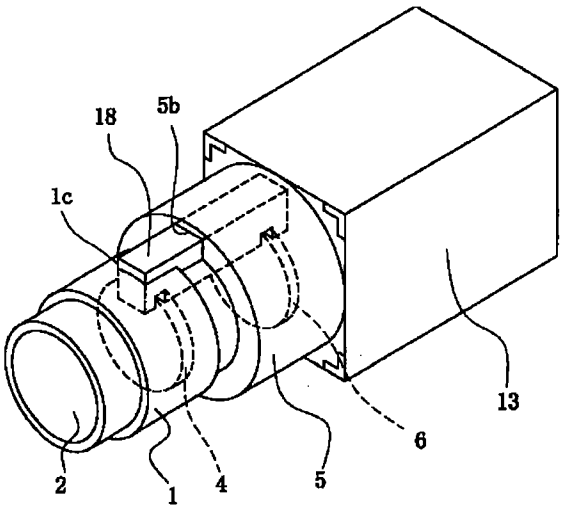
【図８】



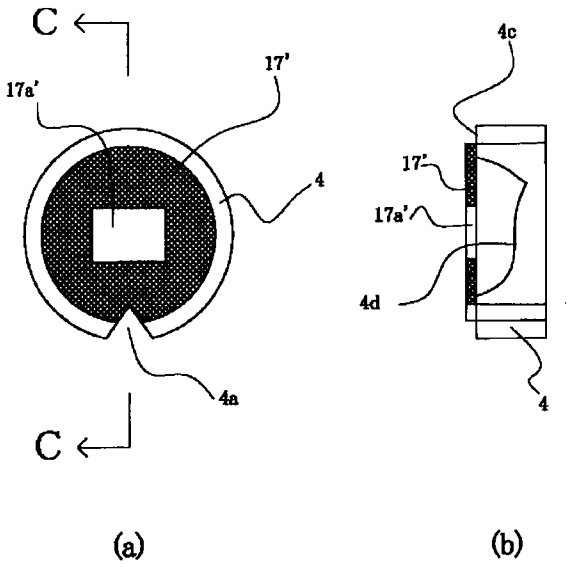
【図５】



【図６】



【図９】



フロントページの続き

(51)Int.Cl.⁷		識別記号	F I		テーマコード（参考）
H０４N	5/225		H０４N	5/225	C　５C０５４
	5/335			5/335	V
	7/18			7/18	M

Ｆターム(参考) 2H040 AA02 CA22 GA02 GA05
2H044 AB25
4C061 AA00 BB02 CC06 DD00 FF40
FF45 JJ06 JJ19 LL02 NN01
PP08 PP11 RR15 UU03
5C022 AA09 AB45 AB62 AC42 AC54
AC65 AC75 AC78 CA00
5C024 AA01 BA03 CA33 EA02 EA04
FA01 FA16 GA51
5C054 AA01 AA05 CA04 CC05 CD01
CE02 CG08 CH07 DA01 EA01
HA12

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-266979

(43)Date of publication of application : 29.09.2000

---

(51)Int.Cl. G02B 7/02

A61B 1/04

G02B 23/24

G02B 23/26

H04N 5/225

H04N 5/335

H04N 7/18

---

(21)Application number : 11-069377 (71)Applicant : OLYMPUS OPTICAL CO LTD

(22)Date of filing : 16.03.1999 (72)Inventor : SUGA TAKESHI

FUJIMORI NORIYUKI

---

(54) IMAGE PICKUP DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an image pickup device capable of positioning accurately and highly precisely an optical system including an optical element having a rotation-asymmetric surface shape.

SOLUTION: This device is provided with an objective optical system including an optical element 4 having a rotationally asymmetric surface shape, a brightness diaphragm 17 having a rotation-asymmetric opening shape, a solid image pickup element 8, and holding means 1, 5 for holding them. Positioning means (noncircular part) 4a, 1a, 1b, 5a in a rotational direction with respect to an optical axis are provided in the solid image pickup element 8 and the holding means 1,

5, and the diaphragm 17 is vapor-deposited on a surface of the optical element 4.

LEGAL STATUS [Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

JPO and INPIT are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] a revolution -- the optical system containing at least one optical element which has the shape of unsymmetrical surface type, and a revolution -- the image pick-up equipment characterized by for the hand of cut to the optical axis of brightness drawing to have carried out location appearance to said optical element, and to establish a means in the image pick-up equipment which has a maintenance means hold brightness drawing which has an unsymmetrical opening configuration, a solid state image pickup device, and said optical element, brightness drawing and a solid state image pickup device, respectively.

[Claim 2] The shaft which is parallel to the direction (a monitor's horizontal direction) of a horizontal (scan) of the pixel array of a solid state image pickup device, and intersects [X / a multiplier and] Z perpendicularly with said Z-axis in the optical axis of optical system, and A, It is image pick-up equipment according to claim 1 which has the shape of surface type expressed on the

three-dimension curved surface with which said optical element fills Z=A (X3+Y3) when the shaft which is parallel to the vertical (it intersects perpendicularly with scanning direction) direction (perpendicular direction on a monitor) of the pixel array of a solid state image pickup device, and intersects perpendicularly with said Z-axis is set as Y.

[Claim 3] Said optical element and/or brightness drawing are image pick-up equipment according to claim 1 to which it has the appearance containing an un-circular part, and revolution positioning to said solid state image pickup device is performed by this un-circular part.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] this invention -- a revolution -- the object optical system containing at least one optical element which has the shape of unsymmetrical surface type, and a revolution -- it is related with the image pick-up equipment which has brightness drawing which has an unsymmetrical opening

configuration, and a solid state image pickup device.

[0002]

[Description of the Prior Art] The electronic endoscope which enabled it to observe by making solid state image pickup devices, such as CCD, build in the long and slender insertion point of an endoscope, transmitting to the image processing system which installed the electrical signal which is made to carry out image formation of the observation image of the part for observation with an objective lens on the image pick-up side of a solid state image pickup device, and is acquired in the exterior of an endoscope through the signal cable, changing into a picture signal, and displaying the image of the part for observation on a monitor in recent years is used widely.

[0003] Moreover, the objective lens used for carrying out image formation on a solid state image pickup device has also diversified the observation image, and the objective lens which has the shape of complicated surface type may be incorporated. for example, PCT/US it is indicated to 96/01514 etc. -- as -- a revolution -- the spatial frequency characteristics of optical system are changed using an unsymmetrical optical element, and the technique to which the depth of field of optical system were expanded is proposed. the case of this technique -- a revolution -- an unsymmetrical optical element -- a revolution -- unsymmetrical -- fading (revolution unsymmetrical aberration) -- since it generates, electric signal

processing amends this dotage and it has the description that cross to the depth of field range larger than the case where the usual lens system is used as a result for whether your being Haruka, and a high-definition image is obtained.

[Problem(s) to be Solved by the Invention]

[0004] By the way, since it constitutes as a premise that an optical image is in a certain specific condition, when an optical image will be in the condition of differing from the thing of a schedule, as for the signal-processing system used for this object, amendment loses its effect, and it usually has the trouble that image quality will deteriorate greatly. moreover -- this kind of image pick-up equipment -- a revolution -- since the optical element which has the shape of unsymmetrical surface type is used, unlike the case where the usual lens symmetrical with a revolution is used, positioning of the high degree of accuracy of an optical element and exact positioning of a hand of cut are needed.

[0005] the place which this invention is made in view of such a trouble that the conventional technique has, and is made into the object -- a revolution -- it is in offering the image pick-up equipment in which the accuracy of the optical system containing the optical element which has the shape of unsymmetrical surface type and positioning of high degree of accuracy are possible.

[0006]

[Means for Solving the Problem] image pick-up equipment according to this

invention in order to attain the above-mentioned object -- a revolution -- the optical system containing at least one optical element which has the shape of unsymmetrical surface type, and a revolution -- in the image pick-up equipment which has a maintenance means hold brightness drawing which has an unsymmetrical opening configuration, a solid state image pickup device, and said optical element, brightness drawing and a solid state image pickup device, respectively, it is characterized by for the hand of cut to the optical axis of brightness drawing to have carried out location appearance to said optical element, and to establish a means.

[0007] The shaft which according to this invention is parallel to the direction (a monitor's horizontal direction) of a horizontal (scan) of the pixel array of a solid state image pickup device, and intersects [X / a multiplier and] Z perpendicularly with said Z-axis in the optical axis of optical system, and A, When the shaft which is parallel to the vertical (it intersects perpendicularly with scanning direction) direction (perpendicular direction on a monitor) of the pixel array of a solid state image pickup device, and intersects perpendicularly with said Z-axis is set as Y, said optical element has the shape of surface type expressed on the three-dimension curved surface with which Z=A (X3+Y3) is filled.

[0008] Moreover, according to this invention, said optical element and/or

brightness drawing have the appearance containing an un-circular part, and revolution positioning to said solid state image pickup device is performed by this un-circular part.

[0009]

[Embodiment of the Invention] Hereafter, it explains based on the example illustrating the gestalt of operation of this invention.

the revolution by which the sectional view showing the whole 1st example configuration of the image pick-up equipment which example 1 drawing 1 requires for this invention (for endoscopes), and drawing 2 (a) are used for the image pick-up equipment of drawing 1 -- the revolution which showed the front view of the optical element which has the shape of unsymmetrical surface type, and drawing 2 (b) in the perspective view, and showed drawing 3 (a) to drawing 2 -- the perspective view and drawing 4 of the front view of the modification of the optical element which has the shape of unsymmetrical surface type, and drawing 3 (b) are the A-A line sectional views of drawing 1 . The concave lens with which one was held among drawing at the lens maintenance frame, and 2 was held at the lens maintenance frame 1, the convex lens with which 3 was held at the lens maintenance frame 1, and the revolution by which adhesion maintenance of 4 was carried out at the lens maintenance frame 1 -- it has the shape of unsymmetrical surface type -- an optical element (It is hereafter called a

revolution unsymmetrical optical element), the CCD maintenance frame with which 5 was attached in the lens maintenance frame 1, The convex lens with which adhesion immobilization of 6 was carried out at the CCD maintenance frame 5, the cover glass with which adhesion immobilization of 7 was carried out at the CCD maintenance frame 5, Solid state image pickup devices, such as CCD by which adhesion immobilization of 8 is carried out in the condition of having made the convex lens 6 and the optical center in agreement at cover glass 7, and bump junction of the flexible lead 9 is carried out at the edge of the field by the side of an image pick-up side, The flare diaphragm attached in the CCD maintenance frame 5 by 10 so that an opening core might be in agreement with the optical center of a convex lens 6, The circuit board by which 11 is held in the field of an opposite hand through the electronic parts (transistor) 12 by which adhesion immobilization was carried out with electric insulation adhesives with the image pick-up side of a solid state image pickup device 8, and each free end of the flexible lead 9 is soldered to the both-sides side, The shielding case with which, as for 13, the CCD maintenance frame 5 was attached, the cable holder in which 14 blockades the opening edge of a shielding case 13, 15 is the signal cable bundle which two or more signal cables connected to two or more connection terminal 11a by which connection immobilization was carried out, respectively, and 16 bundled two or more signal cables 15 to the circuit board 11,

and was inserted in it at the cable holder 14.

[0010] the revolution generated in the revolution unsymmetrical optical element 4 although adhesion immobilization of a convex lens 6, cover glass 7, and the solid state image pickup device 8 of each other is carried out by the optical adhesives of ultraviolet curing and a heat-curing concomitant use mold in the condition of having made the optical center of a flare diaphragm 10 or a solid state image pickup device 8 in agreement with the optical axis of a convex lens 6 -- when unsymmetrical aberration is large, eccentricity of the optical center of a flare diaphragm 10 or a solid state image pickup device 8 may be carried out to an optical axis, and it may be established. With the side in which the electronic parts 12 of the circuit board 11 are formed, although not illustrated, connection immobilization of the electronic parts, such as a chip capacitor and a chip resistor, is carried out with high-melting cream solder in the field of an opposite hand. The polyimide tape is stuck on the flexible lead 9 for electric insulation, the space formed by the CCD maintenance frame 5, the shielding case 13, and the cable holder 14 is filled up with adhesives, and these component parts are fixed in one.

[0011] The configuration of the front face (field by the side of a convex lens 3) of the revolution unsymmetrical optical element 4 is a three-dimension curved surface with which Z=A (X3+Y3) is filled, when the optical-axis core of the object

optical system containing a concave lens 2 and convex lenses 3 and 6 is made into the zero of the X-axis and a Y-axis. The Z-axis, the X-axis, and a Y-axis lie at right angles mutually, the optical axis of object optical system and A are a multiplier, and the X-axis of the Z-axis is [the direction (a monitor's horizontal direction) of a horizontal (scan) of the pixel array of a solid state image pickup device 8, parallel and a Y-axis] in this case, parallel to the vertical (it intersects perpendicularly with scanning direction) direction (perpendicular direction on a monitor) of the pixel array of a solid state image pickup device 8. As shown in drawing 2 , the brightness drawing 17 which has square opening 17a is formed in this front face by vacuum evaporationo, and the flux of light which has penetrated and carried out incidence of a concave lens 2 and the convex lens 3 is extracted to predetermined magnitude.

[0012] The rear face (field by the side of a convex lens 6) of the revolution unsymmetrical optical element 4 is a flat surface, and adhesion immobilization of the periphery section is carried out at the lens maintenance frame 1 in the condition of it having been attached to the striking portion prepared in the lens maintenance frame 1, and having been guessed and positioned. Moreover, un-circular section 4a is prepared in a part of periphery of the revolution unsymmetrical optical element 4, and positioning of the hand of cut of the revolution unsymmetrical optical element 4 is performed by engaging with

un-circular section 1a (referring to drawing 4) by which this un-circular section 4a was formed in the inner skin of the lens maintenance frame 1 corresponding to this. In this example, the un-circular section is formed by making flat the part which the periphery section of a circular lens counters. Therefore, positioning of high degree of accuracy uses the revolution unsymmetrical optical element 4 also as the hand of cut centering on an optical axis to the lens maintenance frame 1. In the example shown in drawing 2 , although un-circular section 4a is prepared only in one place of the revolution unsymmetrical optical element 4, it may be prepared in two places which counter as shown in drawing 3 , and the number is not limited. In this case, it is not necessary to say that un-circular section 1a is prepared in two places also corresponding to the lens maintenance frame 1. Although not illustrated, the un-circular section is similarly prepared in the lens maintenance frame 1 and the CCD maintenance frame 5, respectively, and the hand of cut is positioned by making un-circular section 1b of the lens maintenance frame 1, and un-circular section 5a of the CCD maintenance frame 5 engaged. That is, the revolution unsymmetrical optical element 4 and a solid state image pickup device 8 will be positioned by high degree of accuracy in the hand of cut centering on an optical axis. In the case of the configuration with which the shape of surface type of the revolution unsymmetrical optical element 4 fills Z=A (X3+Y3) by the above So that it may become parallel [the X-axis / the

direction (horizontal direction on a monitor) of a horizontal (scan) of the pixel array of a solid state image pickup device 8, parallel, and a Y-axis] to the vertical (it intersects perpendicularly with scanning direction) direction (perpendicular direction on a monitor) of the pixel array of a solid state image pickup device 8 It becomes possible to position to high degree of accuracy in the hand of cut centering on an optical axis (Z-axis).

[0013] Here, the manufacture approach of the revolution unsymmetrical optical element 4 is explained. Although this revolution unsymmetrical optical element 4 is formed with a mould or a press, as shown in drawing 2 , in that formation process, alignment mark (reference mark) 4b is prepared in the part on the front face of a component which the flux of light does not pass optically. For example, although not illustrated, the mold of alignment mark 4b is engraved in the press die with the shape of surface type of a component, and alignment mark 4b is driven into forming the shape of surface type of a component at a press process, and coincidence. At least two alignment mark 4b is prepared as shown in drawing 2 and 3, for example, it is carrying out the cross-joint mold. Next, patterning of the opening 17a of the brightness drawing 17 formed of vacuum evaporationo on the basis of this alignment mark 4b is carried out. although the configuration of opening 17a was made into the square in the example -- a rectangle and an octagon -- circular -- in addition to this, it is good anyway.

Moreover, the core of the revolution unsymmetrical optical element 4 and the core of opening 17a may be ******** carried out. Un-circular section 4a is similarly processed on the basis of alignment mark 4b.

[0014] thus, a revolution -- since alignment mark 4b is engraved at the time of manufacture even if it is an unsymmetrical optical element, it is possible to be able to distinguish the directivity of a component easily in degree process, and to form optical drawing with high degree of accuracy on the front face of a component by vacuum evaporationo on the basis of this alignment mark 4b. Since processing processing is carried out after the un-circular section of a component appearance is also positioned with high degree of accuracy on the basis of alignment mark 4b, it becomes possible to manufacture this light source study component with a high precision, and highly precise positioning and the maintenance of a component of within the limit [lens] are easy. Moreover, since alignment mark 4b is engraved on the part which a beam of light does not pass, any effect is not done optically.

[0015] by the way -- the image pick-up equipment by this invention -- the revolution unsymmetrical optical element 4 -- a revolution -- unsymmetrical -- fading (revolution unsymmetrical aberration) -- since it has generated -- the usual focus appearance -- carrying out -- it cannot do. photographic subjects, such as a chart, are put on a predetermined location, usual carries out focus

appearance (adjustment of the direction of an optical axis (Z direction)), observing the image by the monitor, the direction of an optical axis of the lens maintenance frame 1 and the CCD maintenance frame 5 is adjusted so that a focus may suit, and he is trying to fix both in an activity however -- this example -- the revolution unsymmetrical optical element 4 -- a revolution -- unsymmetrical -- fading (revolution unsymmetrical aberration) -- since it has generated -- the above usual focus appearance -- carrying out -- it cannot do. therefore, signal processing electric in the case of this example -- using together -- a revolution -- unsymmetrical -- fading (revolution unsymmetrical aberration) -- it is made to work by a **** carrying out focus appearance, observing the amended image by the monitor.

[0016] Moreover, leave a degree of freedom (ASOBI) to un-circular section 1b (refer to drawing 4) formed in the peripheral face of the lens maintenance frame 1, and un-circular section 5a (refer to drawing 1) formed corresponding to the inner skin of the CCD maintenance frame 5, and it is made to put on it. the above-mentioned signal processing was used together -- focus appearance is carried out, and in the case of an activity, the hand of cut of the lens maintenance frame 1 and the CCD maintenance frame 5 is adjusted, and you may make it fix to it in this case, since it can work simultaneously by optical system's carrying out focus appearance and the hand of cut of the revolution

unsymmetrical optical element 4 carrying out location appearance to an activity, it is convenient. Moreover, since it adjusts based on an image, the amount of gaps between the aberration currently assumed by signal processing and the aberration generated in actual optical system can be made into min. Therefore, while being able to raise image quality, it becomes possible to also raise the yield in a manufacture phase.

[0017] thus -- according to this example -- a revolution, even if it uses the optical element which has the shape of unsymmetrical surface type since the hand of cut to the optical axis like the un-circular section corresponding to the lens maintenance frame holding this optical element and this optical element carried out location appearance and the means was established this optical element -- high degree of accuracy -- it can position -- moreover, a revolution -- since brightness drawing which has an unsymmetrical opening configuration is also vapor-deposited by the front face of this optical element, it is similarly positioned with high degree of accuracy, and sufficient optical-character ability can be realized.

[0018] The front view of a different revolution unsymmetrical [that the sectional view showing the whole 2nd example configuration of the image pick-up equipment which example 2 drawing 5 requires for this invention (for endoscopes), the appearance perspective view of the image pick-up equipment

which showed drawing 6 to drawing 5 , the perspective view of the revolution unsymmetrical optical element used for the image pick-up equipment which showed drawing 7 to drawing 5 , and drawing 8 were shown in the B-B line sectional view of drawing 5 , and drawing 9 (a) be shown in drawing 7] optical element, and drawing 9 (b) are the C-C line sectional views of drawing 9 (a). The same sign is used for the same member and the same part on having been shown in the 1st example, and parenchyma among drawing, and explanation is omitted. As for this example, the structure of the revolution unsymmetrical optical element 4 and the installation structure to the lens maintenance frame 1 of this component 4 differ from the 1st example. namely, in the front face (field by the side of a convex lens 3) of the revolution unsymmetrical optical element 4 Annular flat-surface section 4c by which un-circular section (key way of direction of optical axis) 4a and alignment mark 4b were drilled in a part of circular appearance as clearly shown by drawing 7 , 4d of the same three-dimension curved-surface sections as the 1st example which projected more slightly than this flat-surface section 4c is formed, and the brightness drawing 17 which has opening 17a is formed by vacuum evaporationo on 4d of this three-dimension curved-surface section. In this case, 4d of three-dimension curved-surface sections is formed in the location dented rather than flat-surface section 4c as shown in drawing 9 , and you may make it vapor-deposit the brightness drawing

[0019] The rear face (field by the side of a convex lens 6) of the revolution unsymmetrical optical element 4 is a flat surface, and this component 4 is fixed by pasting up the periphery section on the lens maintenance frame 1, where flat-surface section 4c is dashed and positioned to the striking portion in which it was prepared by the lens maintenance frame 1, as shown in drawing 5 . In this example, positioning of the hand of cut of the revolution unsymmetrical optical element 4 is performed by fitting in a key 18 common to un-circular section 4a and the un-circular sections (key way) 1c and 5b formed in the lens maintenance frame 1 and the CCD maintenance frame 5 corresponding to this. Thereby, the revolution unsymmetrical optical element 4 may be positioned with high degree of accuracy to the lens maintenance frame 1 and the CCD maintenance frame 5 also in the surrounding hand of cut of an optical axis.

[0020] In this example, although every one all were formed in the lens maintenance frame 1, the revolution unsymmetrical optical element 4, and the CCD maintenance frame 5 as a concave mold groove, respectively, the un-circular sections 1c, 4a, and 5b These may be prepared in two or more places, and it is formed in one place or two or more places as V mold groove (refer to drawing 9 (a)) or a U mold groove, and you may make it a cross-section configuration use what was formed in the V type or U mold corresponding to this

also as for a key 18. Furthermore, a convex type is formed instead of a concave mold groove, and this convex type may be made to engage with key way 1c. Moreover, the brightness drawing 17 may be constituted by joining plate-like brightness drawing 17' which has opening 17a' made by flat-surface section 4c for example, with the phosphor bronze plate etc. as shown in drawing 9 , although formed of vacuum evaporationo on 4d of three-dimension curved surfaces. In this case, if un-circular section 4a, such as a convex type, V mold groove, or U mold groove, is prepared and placed after joining brightness drawing 17' to the revolution unsymmetrical optical element 4 and unifying, positioning of a hand of cut is possible similarly. In addition, each side of opening 17a of the brightness drawing 17 and 17' and 17a' is parallel to the X-axis and a Y-axis respectively, and the core is in agreement with an optical axis. In addition, since the operation effectiveness of this example is the same as that of them of the 1st example, explanation is omitted.

[0021] As explained above, the image pick-up equipment of this invention has the following description other than the description indicated to the claim.

(1) the image pick-up equipment according to claim 1 currently formed in said optical element on the basis of said alignment mark in which location appearance was carried out and the means was formed on the front face of said optical element.

[0022] (2) Said brightness drawing is image pick-up equipment according to claim 1 vapor-deposited by the front face of said optical element.

[0023] (3) It is image pick-up equipment according to claim 1 which said brightness drawing is attached to the predetermined location on said front face of an optical element which has the un-circular section in one, and is held at said maintenance frame when said optical element makes said un-circular section engage with the un-circular section formed corresponding to said maintenance frame.

[0024] (4) The opening configuration of said brightness drawing is image pick-up equipment according to claim 1 which is a rectangle or a square.

[0025] (5) Image pick-up equipment according to claim 1 which was made to perform while using the image processing together for positioning with the object optical system containing said optical element, and said solid state image pickup device and observing the picture signal from said solid state image pickup device by the television monitor.

[0026] (6) a revolution -- the approach characterized by engraving a reference mark in the approach of manufacturing the optical element which has the shape of unsymmetrical surface type at the same time it forms the shape of said surface type, and performing post-processing processing of said optical element based on this reference mark.

[0027] (7) The shaft which is parallel to the direction (a monitor's horizontal direction) of a horizontal (scan) of the pixel array of said solid state image pickup device, and intersects [X / a multiplier and] Z perpendicularly with said Z-axis in the optical axis of said object optical system, and A, It is the manufacture approach of the optical element according to claim 1 which is the three-dimension curved surface with which the shape of surface type of said optical element fills Z=A (X3+Y3) when the shaft which is parallel to the vertical (it intersects perpendicularly with scanning direction) direction (perpendicular direction on a monitor) of the pixel array of said solid state image pickup device, and intersects perpendicularly with said Z-axis is set as Y.

[0028]

[Effect of the Invention] according to [like / ****] this invention -- irrespective of an easy configuration -- a revolution -- highly precise positioning of the object optical system containing the optical element which has the shape of unsymmetrical surface type is possible, and the image pick-up equipment which can be brought into the large depth of field range, and can obtain a high-definition image can be offered.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the whole 1st example configuration of the image pick-up equipment concerning this invention.

[Drawing 2] the revolution for which (a) is used in the 1st example -- the front view of the optical element which has the shape of unsymmetrical surface type, and (b) are the perspective view.

[Drawing 3] The front view of the modification of the optical element which showed (a) to drawing 2 , and (b) are the perspective view.

[Drawing 4] It is the sectional view which meets the A-A line of drawing 1 .

[Drawing 5] It is the sectional view showing the whole 2nd example configuration of the image pick-up equipment concerning this invention.

[Drawing 6] It is the appearance perspective view of the image pick-up equipment shown in drawing 5 .

[Drawing 7] the revolution used for the 2nd example -- it is the perspective view of an optical element which has the shape of unsymmetrical surface type.

[Drawing 8] It is the sectional view which meets the B-B line of drawing 5 .

[Drawing 9] a different revolution from (a) having been shown in drawing 7 -- the front view of the optical element which has the shape of unsymmetrical surface

type, and (b) are sectional views which meet the C-C line of (a).

[Description of Notations]

1 Lens Maintenance Frame

1a Un-circular section

1b Un-circular section

1c Un-circular section

2 Concave Lens

3 Six Convex lens

4 Revolution -- Optical Element Which Has the Shape of Unsymmetrical Surface

Type

4a Un-circular section

4b Alignment mark

4c Flat-surface section

4d Three-dimension curved-surface section

5 CCD Maintenance Frame

5a Un-circular section

5b Un-circular section

7 Cover Glass

8 Solid State Image Pickup Device

9 Flexible Lead

10 Flare Diaphragm

11 Circuit Board

11a Connection terminal

12 Electronic Parts

13 Shielding Case

14 Cable Holder

15 Signal Cable

16 Signal Cable Bundle

17 17' Brightness drawing

17a, 17a' Opening

18 Key